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(54) Prefabricated built-up building construction.

(57) A method of constructing a prefabricated building comprising fabricating structural units (1) at a factory, and connecting the structural units (1) together at a building site to form a building. Each structural unit (1) comprises steel columns and beams connected together into a steel frame. Each structural unit (1) contains prefabricated features such as construction braces, floor slabs, wall boards, windows, stairs and elevator shafts. The structural units (1) may be joined by bolts or by welding. This invention reduces the amount of work which takes place on the building site, and makes the building less difficult to repair since structural units may be replaced.

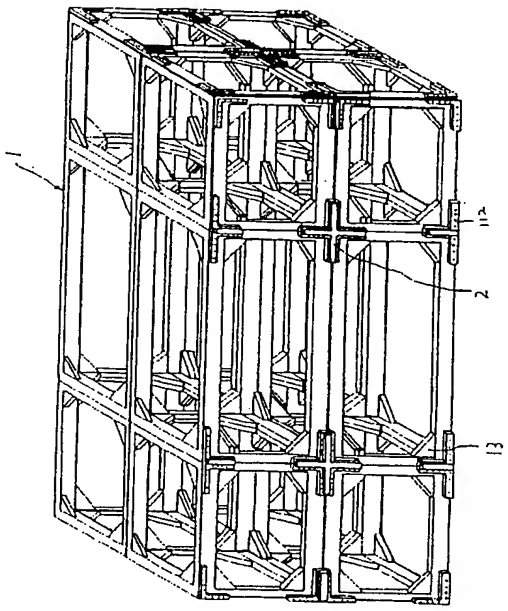


Fig. 1

EP 0 558 315 A1

BACKGROUND OF THE INVENTION

The present invention relates to the construction of buildings and relates more particularly to contructing prefabricated built-up buildings for building up a building by connecting prefabricated structural units together.

The construction of a building is not an easy job. Before the construction of a building, a series of complicated procedures including geological surveying, designing of the construction plan, etc., must be done. During the construction work, the foundation is constructed first, and then the structure of the building is constructed. After the formation of the structure, floor slabs, wall boards, windows, water piping and electric wiring, air conditioner system, fire-fighting system, partitions, interior and exterior upholstery are properly made. According to conventional constructions, these parts are made at a building site by various workers step by step. However, it is not easy to move manpower about according to needs. Quality control is another task which is difficult to achieve. In order to maintain the quality and reduce the cost, industrialized construction is the way ahead. The so-called industrialized construction is to prefabricate most parts of a building at a factory and then assemble the parts at the building site. Various prefabricated constructions have been proposed and applied to building a variety of houses. However, normal prefabricated constructions simply comprise preparing floor slabs, wall boards and partition boards for quick installation after the construction of the structure of a building. Because the structure of a building is made separately at the building site, the cost, progress and quality of the building are still difficult to control. Prefabricated reinforced concrete house construction is also proposed. The size of a structural unit made according to this prefabricated reinforced concrete house construction is restricted by the conditions of its transportation. In general, conventional construction has various defects which are outlined hereinafter.

1. A building constructed according to conventional methods is difficult to repair. Because the structure of a building is made of reinforced concrete or structural steels, and constructed at the building site, it cannot be pulled down or dismantled for repair work when it is damaged after a fire or earthquake.
2. During the construction of a building, the nearby environment and traffic conditions are unfavourably affected. According to conventional constructions, a variety of construction materials are frequently delivered to the building site and put here and there, obstructing the traffic.
3. The construction of a building according to conventional methods will cause environmental pollution. High noise and dust levels and waste materials will be produced during the construction of a building, affecting the health and living conditions of the people living or working nearby.
4. The construction of a building according to conventional methods needs a long time schedule, and therefore the construction materials and manpower are difficult to control.
5. A building constructed according to conventional methods provides little flexibility. Once a building is constructed, it can not be conveniently moved from place to place.
6. It is expensive to construct a building according to conventional methods. Because the structure and most parts of the building are made at the building site, they cannot be made through mass production to reduce the unit cost.
7. A prefabricated house according to the prior art is divided into several parts made at a factory, then the parts are set up at the building site and then connected by concrete. Once a prefabricated house is set up, it cannot be pulled down and moved to another place, and its size cannot be extended further.
8. A prefabricated reinforced concrete house constructed according to the prior art is limited in size. When installed, the walls bear the load and cannot be pulled down. Therefore, its size cannot be extended as desired.

SUMMARY OF THE INVENTION

An object of the present invention is to construct a prefabricated built-up building which allows the structure, floor slabs, wall boards, steps, windows and elevator shaft to be prefabricated at a factory and then set up at the building site. Another object of the present invention is to construct a prefabricated built-up building which shortens the time schedule of the construction of a building. Still another object of the present invention is to construct a prefabricated built-up building which reduces inconvenient obstructions to the nearby traffic during the construction of a building. Still another object of the present invention is to construct a prefabricated built-up building which allows a building to be conveniently pulled down and reassembled after its deconstruction. Still another object of the present invention is to construct a prefabricated built-up building which has simpler budget control during construction.

According to the present invention, the construction of the prefabricated built-up building includes prefabricating structural units at a factory, and then connecting the structural units horizontally and vertically at the building site according to the construction plan. The structural units may be made in different sizes and shapes according to different requirements. They are made by connecting steel columns and beams into steel frames. Each steel frame is respectively

constructed with braces, floor slabs, wall boards, windows, stairs and/or elevator shaft. The structural units may be directly welded to one another, or fastened with connecting steel plates by bolts and then connected together by connecting each steel plate on one structural unit to an adjacent steel plate on another structural unit by a respective reinforcement plate by a welding process. Because less work is done at the building site, industrialized construction can be achieved.

BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1 and 2 illustrate several structural units made in different sizes (before mounting of wall boards, floor slabs, windows, ceiling, etc.) according to the present invention;

Fig. 3 illustrates several structural units connected horizontally;

Fig. 4 illustrates connecting steel plates fastened to the steel columns and beams by bolts and connected to one another by reinforcement plates by welding;

Fig. 5 illustrates projecting cones and recessed tapering holes respectively made on the bottom and top surfaces of each structural unit and guide members positioned for building an upper structural unit into position;

Fig. 5-1 is a cross section in an enlarged scale showing the relative positions of a projecting cone and a recessed tapering hole;

Fig. 5-2 illustrates a cone projection engaged in a recessed tapering hole;

Figs. 6, 7 and 8 illustrate several buildings constructed according to the present invention;

Fig. 9 illustrates an alternate form of the structural unit;

Fig. 10 illustrates several structural units connected horizontally and vertically;

Fig. 11 illustrates connecting steel plates fastened to each structural unit by bolts, and reinforcement plates welded to the connecting steel plates of each two contiguous structural units in connecting the structural units together;

Fig. 12 is a cross section showing the installation of prefabricated wall boards and floor slabs;

Fig. 13 is a plan view showing the connection of wall boards to the steel columns of each structural unit; and

Fig. 14 is a perspective elevational view in an enlarged scale, showing the connection of wall boards to the steel columns of contiguous structural unit.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to Figs. 1 and 2, structural units 1 which consist of steel columns and beams are made in the desired sizes and shapes, and then constructed with braces, floor slabs, wall boards, windows, stairs, and/or elevator shafts according to the construction plan.

Referring to Figs. 3, 4, 5-1 and 5-2, reinforcing angle irons 13 are respectively fastened to the interior angles between the columns and beams of the structural unit 1. Connecting steel plates 112 are respectively fastened to the columns and beams by bolts to connect prepared structural units 1 together. Reinforcement plates 2 are respectively welded to the connecting steel plates 112 in connecting one structural unit to another. Cone projections 113 and recessed tapering holes 1131 are respectively made on each structural unit 1 at the top or bottom (see Fig. 5-1). During the construction of the building, prepared structural units 1 may be respectively lifted by a construction hoist or like machine and then connected vertically by means of guide members 114. When two structural units 1 are piled up together, the cone projections 113 on the lower structural unit 1 are respectively engaged in the recessed tapering holes 1131 on the upper structural units 1. By means of engaging the sloping surface 1132 on the projecting cones 113 with the sloping surface 1133 on the recessed tapering holes 1131, the upper structural unit 1 becomes securely positioned on the lower structural unit 1. This arrangement eliminates positioning errors which may occur due to structural tolerance between two connected structural units 1. Therefore, prepared structural units 1 can be conveniently set up and formed into a building. The building thus constructed can be conveniently taken down. By removing the bolts from the connecting steel plates 112, the connecting steel plates 112 and the reinforcement plates 2 are detached from the structural units 1, and then the structural units 1 can be separated from one another.

Referring to Figs. 10 and 11, when various structural units 1 are to be connected longitudinally and laterally (see Fig. 10), it is very difficult to weld inside the connecting steel plates 112 from the outside. Under this situation, connecting steel plates 112 are respectively fastened to each structural unit 1 by bolts, and then reinforcement plates 2 are respectively welded to the connecting steel plates 112 of each two contiguous structural units 1 in connecting the structural units 1 together. If the building thus constructed is to be taken down, the reinforcement plates 2 are respectively cut off at portion 2' (see Fig. 11), and the bolts are respectively removed from the connecting steel plates 112, and then the structural units 1 can be separated from one another. For constructing a permanent building, the prepared structural units 1 can be directly fastened together by reinforcement plates 2 by welding. Further, the shape and size of the reinforcing angle irons 13 are determined according to the cross section and stress of the columns and

beams to be connected.

Referring to Figs. 12, 13 and 14, when several structural units 1 are connected together, gaps are maintained between the floor slabs of each two contiguous structural units 1. During the assembly process, the spaces for floor beams are respectively filled up with packing material 4 and then covered with concrete 5, and then pre-fabricated floor slabs 3 are matched. Locating steel plates 16 are respectively fastened to each structural unit 1 for mounting exterior wall boards and partition wall boards or the anchors therefor. Wall boards 6 are prefabricated at factory during the production of each structural unit 1. When a building is set up, any partition wall board can be pulled down as desired. Fireproof covering layers 7 are respectively covered over the columns and beams of each structural unit 1 (see Fig. 12). When prepared structural units 1 are connected and set up into a building, the connecting gaps between structural units 1 are covered with fireproof covering layers 7. Ceiling boards 8 are also prefabricated at the factory during the production of each structural unit 1. Spaces 9 are maintained at corner areas during the installation of ceiling boards 8 at factory, which are covered with ceiling boards at the building site after the designed building has been set up. Wall boards 6 are fastened to the locating steel plates 16 of each structural unit 1 before the construction. Prefabricated cover panels 10 are then fastened to the grooves 17 on the wall boards 6 by screws or by welding, after the prepared structural units 1 have been set up at the building site, and covered over the columns and beams of all structural units 1. After the installation of cover panels 10, the gaps between the wall boards 6 and the cover panels 10 are sealed by waterproof, heat-resisting filling elements 15. Therefore, the exterior water proofing is done. The water proofing of the roof is done according to the type of the prefabricated roof. For example, it can be done at the building site after the construction of the building if the roof is of the type shown in Fig. 12. When set up, load is transmitted to the foundations 14 through the columns and beams of the respective structural units 1 (the foundation 14 is not within the scope of the present invention, and therefore it is not necessary to explain its construction in detail). The wall boards may be made at the factory during the production of each structural unit, or installed at the building site after the construction of the designed building. Further, the wall boards may be made of reinforced concrete or any of a variety of suitable materials.

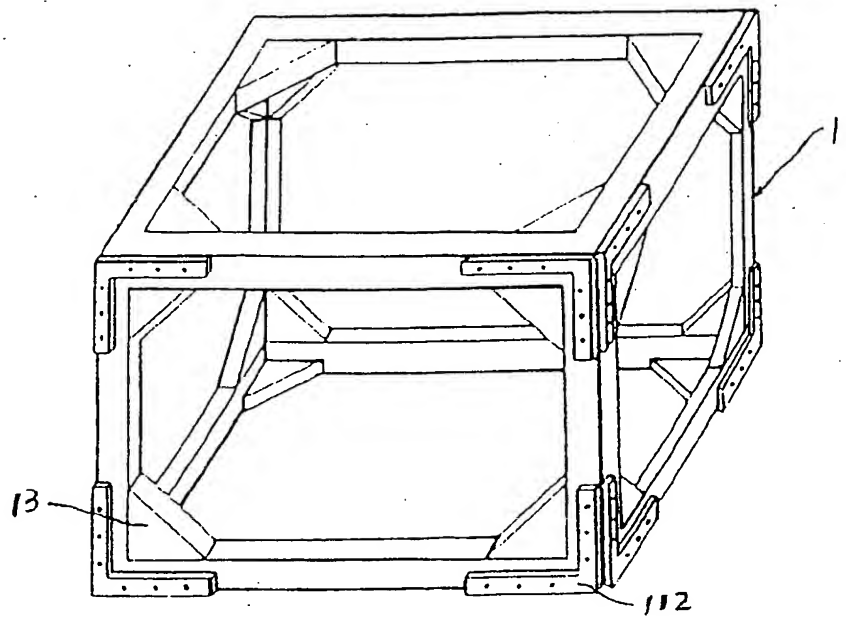
As indicated, structural units 1 may be made in different shapes, sizes and load-carrying capacities, and respectively classified for quick construction. The structural load-carrying capacity may be determined according to different considerations. For example, the building may be relatively enlarged so that the building thus formed can be further extended several years after its construction. The present invention also allows a building to be re-assembled. Flexible tolerance is also maintained for the foundation pile. Therefore, the limited land space can be fully utilized. Because structural units and most parts and accessories are prefabricated and then built up at the building site, no waste materials will be produced during the construction of a building.

Claims

1. A method of constructing a prefabricated built-up building comprising a step of fabricating structural units at factory, and a step of connecting said structural units together at a building site by bolts or by welding to form a building, characterised in that said structural units are formed by connecting steel columns and beams into steel frames arranged according to the construction plan of the building to be constructed, and by constructing braces, floor slabs, wall boards, windows, stairs and/or elevator shaft within or attached to the structural units and then respectively connecting the structural units to one another.

2. A method according to claim 1 wherein said structural units are respectively connected together and formed into said building by welding the steel columns and beams of one structural unit to those of a contiguous structural unit.

3. A method according to claim 1 wherein said structural units are respectively connected together and formed into said building by fastening connecting steel plates to the steel columns and beams of each structural unit by bolts and then welding reinforcement plates to said connecting steel plates for permitting each two contiguous structural units to be tied together.



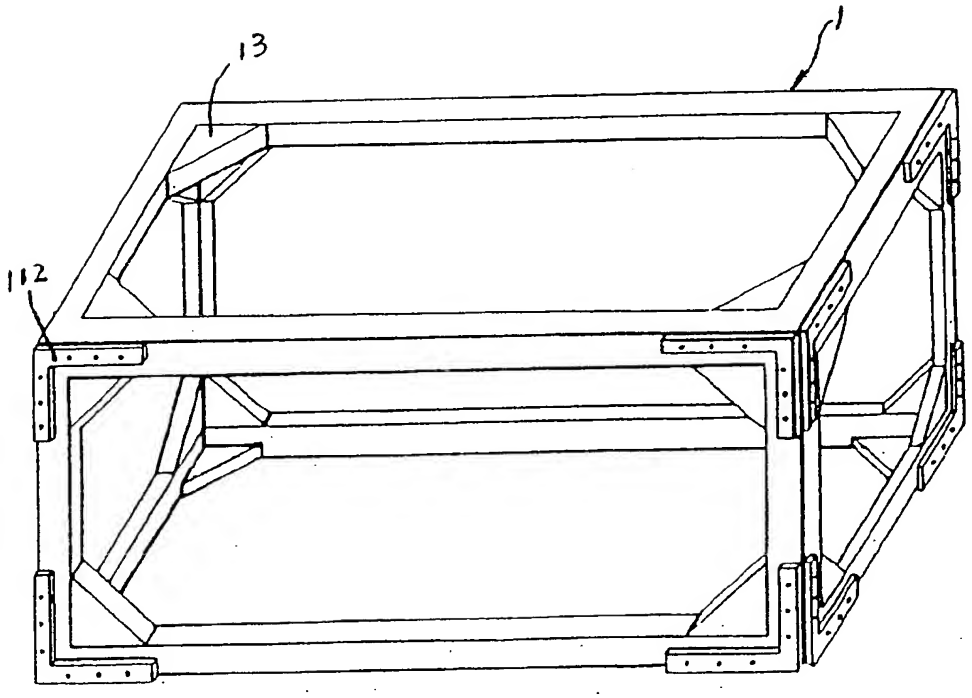


Fig 1

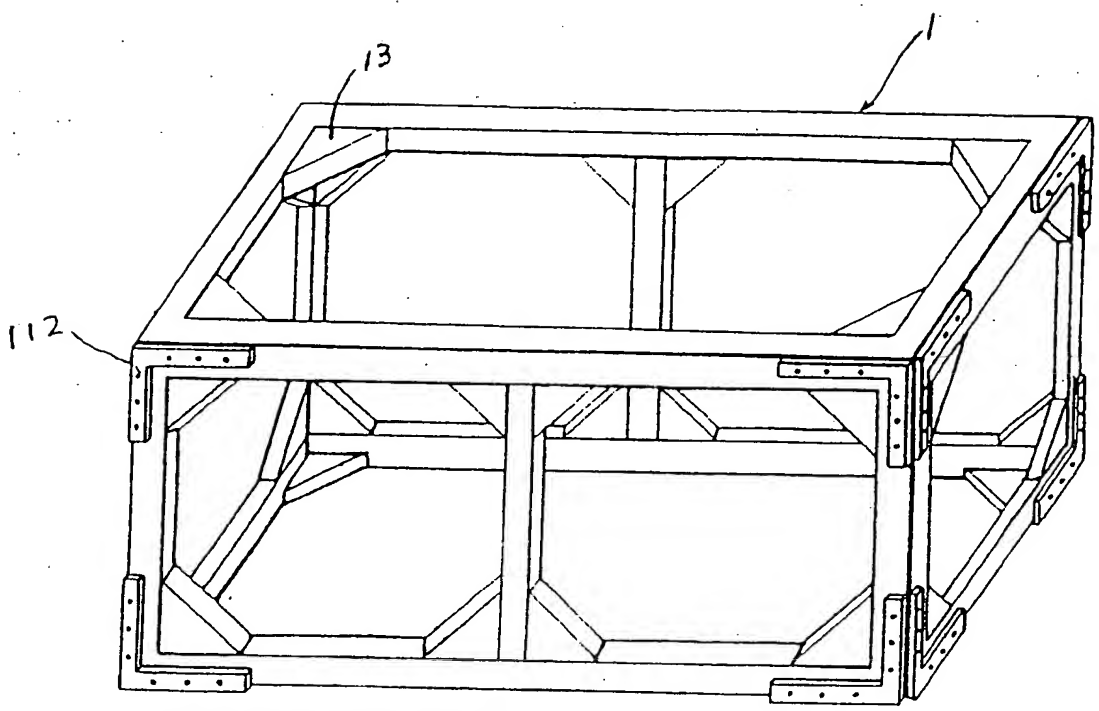


Fig 2

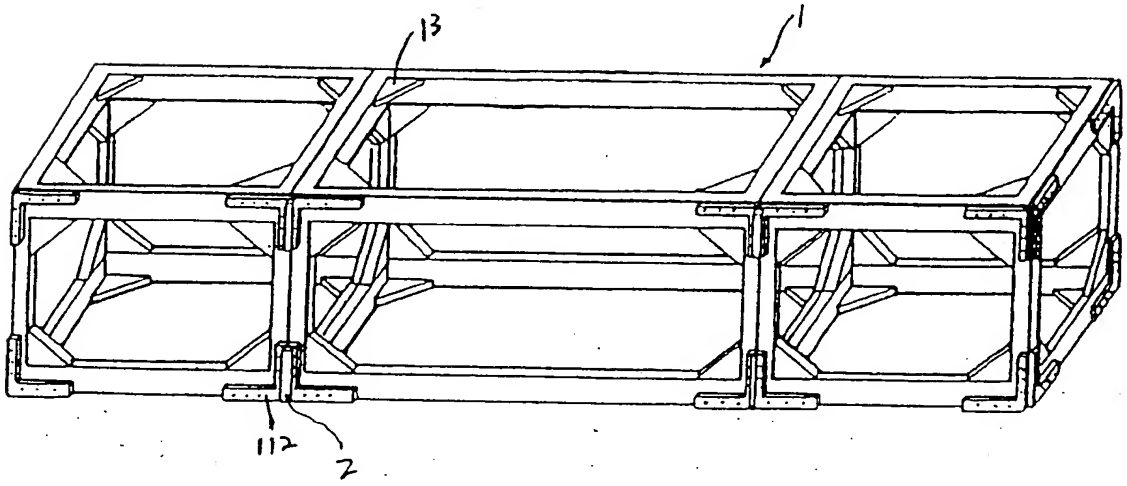


Fig 3

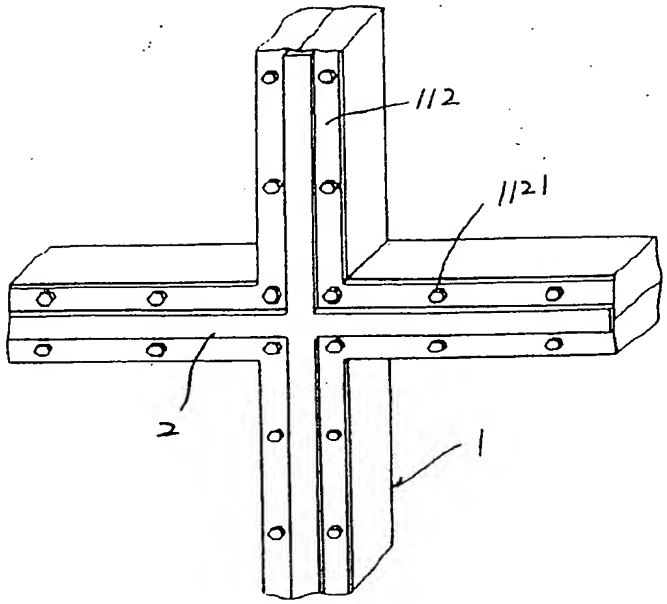


Fig 4

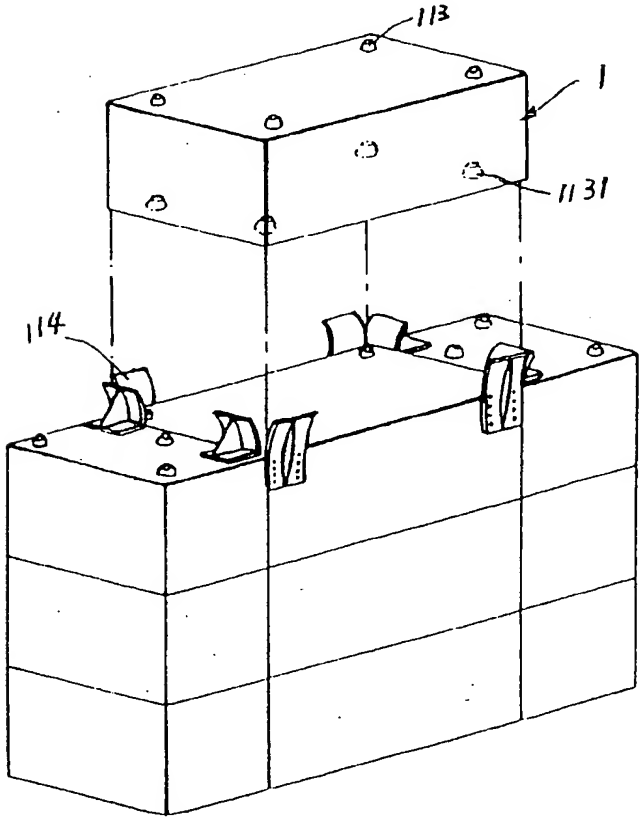


Fig 5

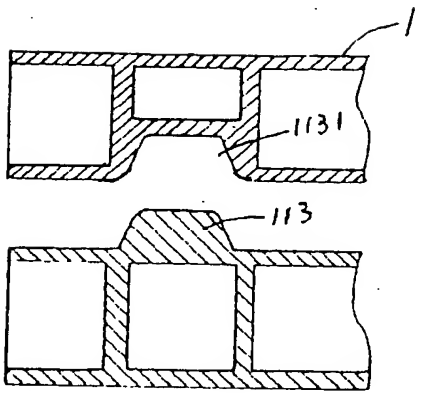


Fig 5 - 1

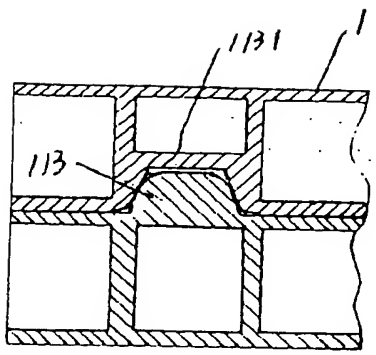


Fig 5 - 2

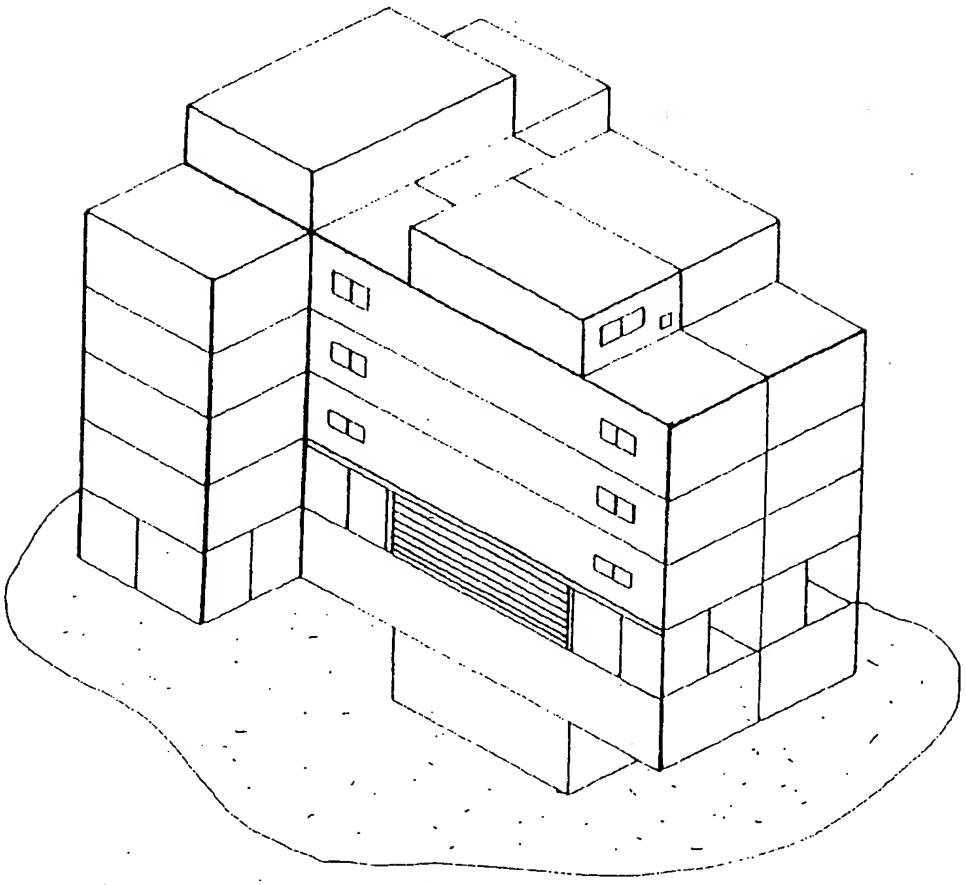


Fig. 6

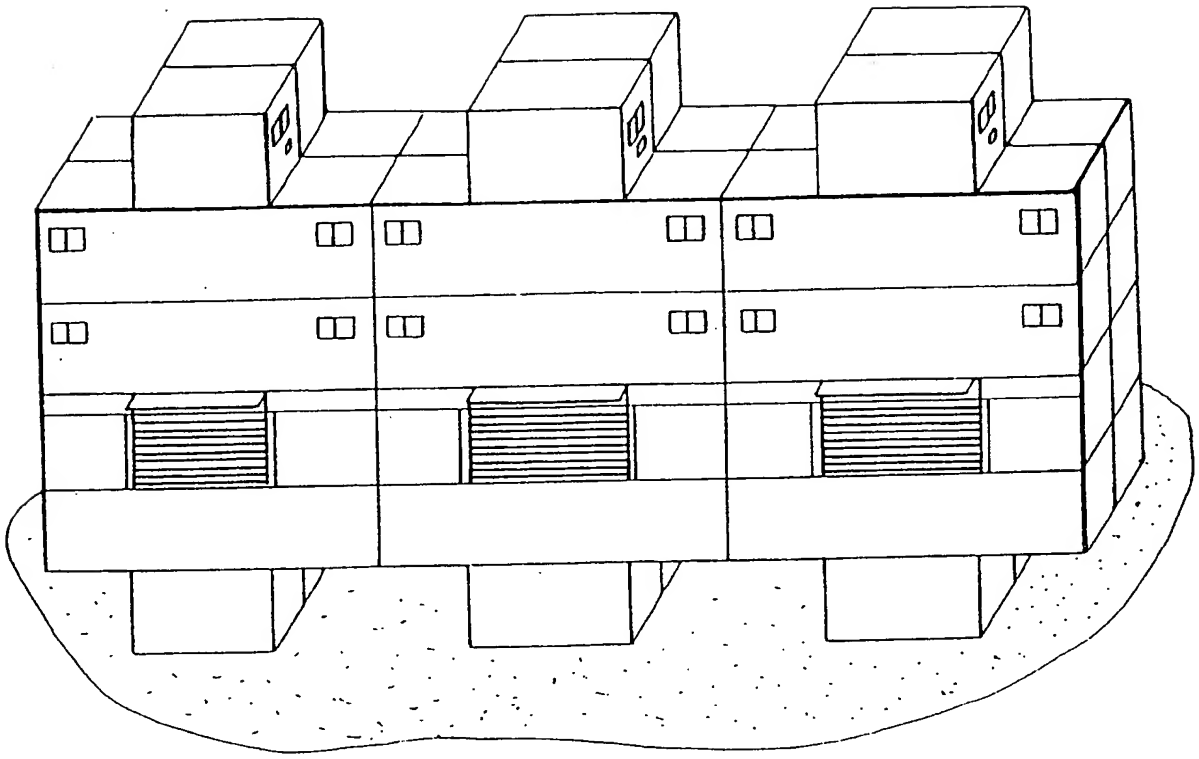


Fig 7

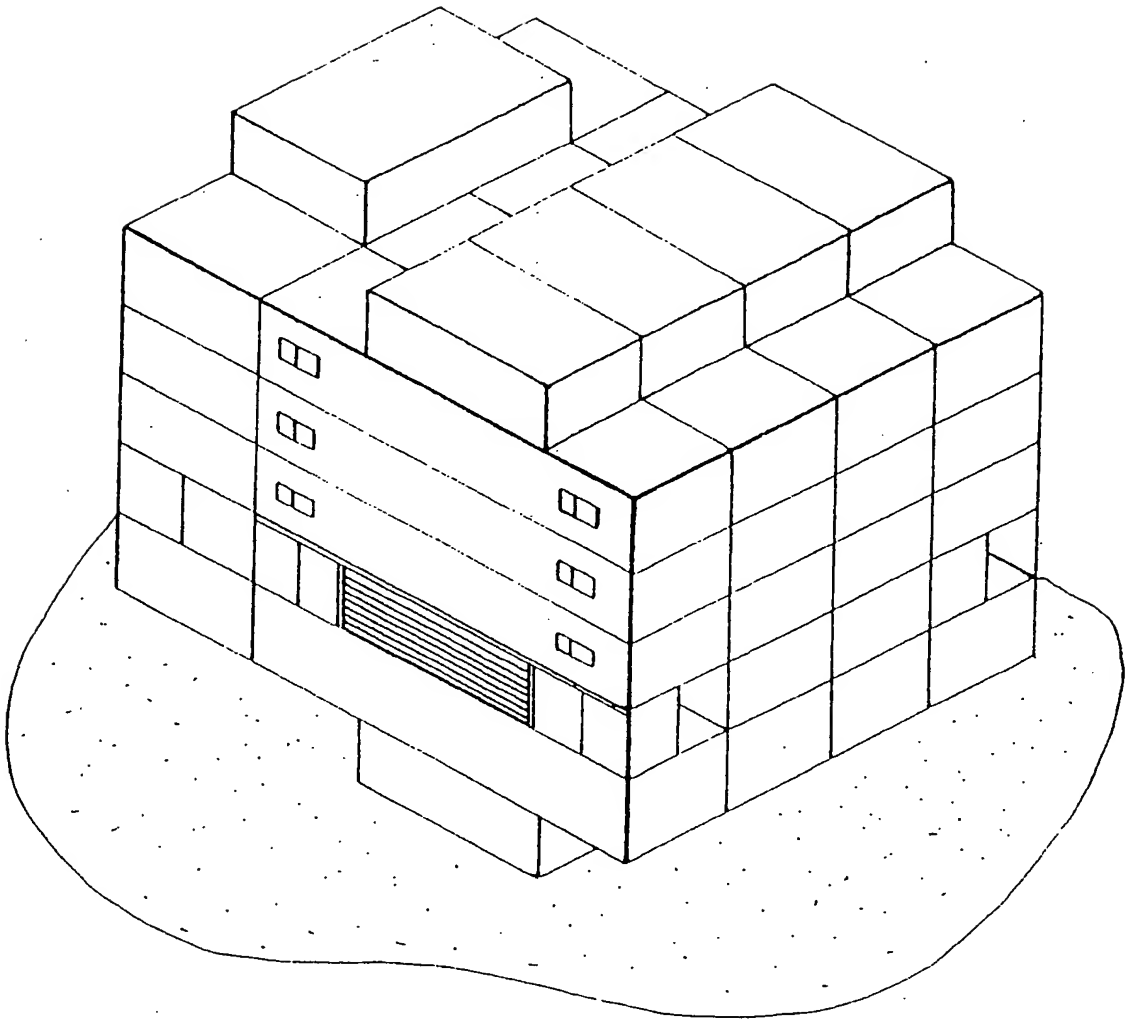


Fig 8

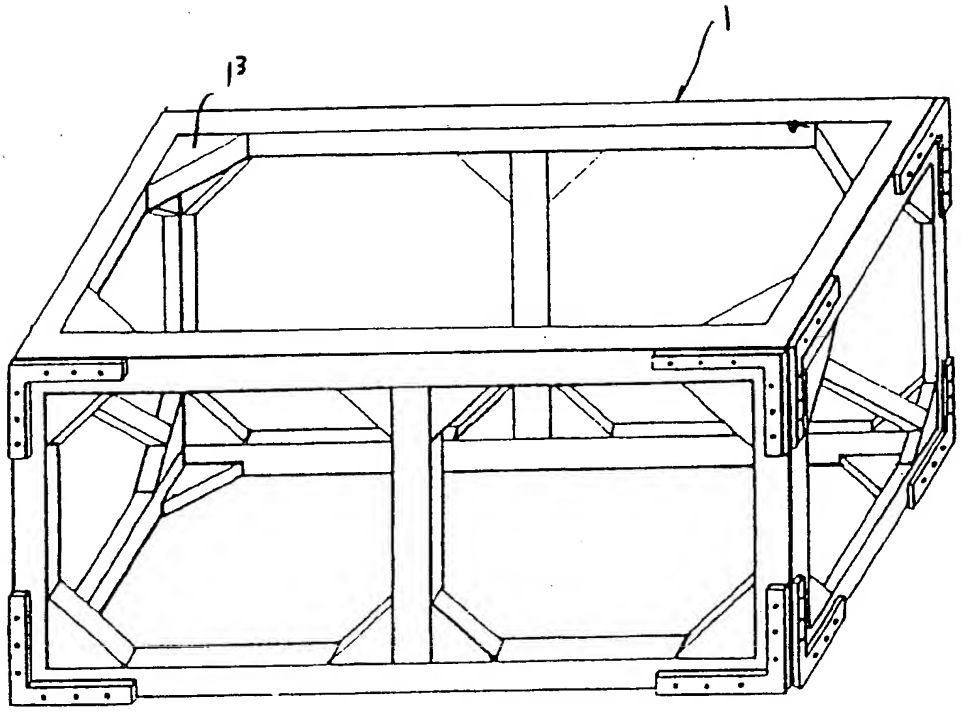


Fig 9

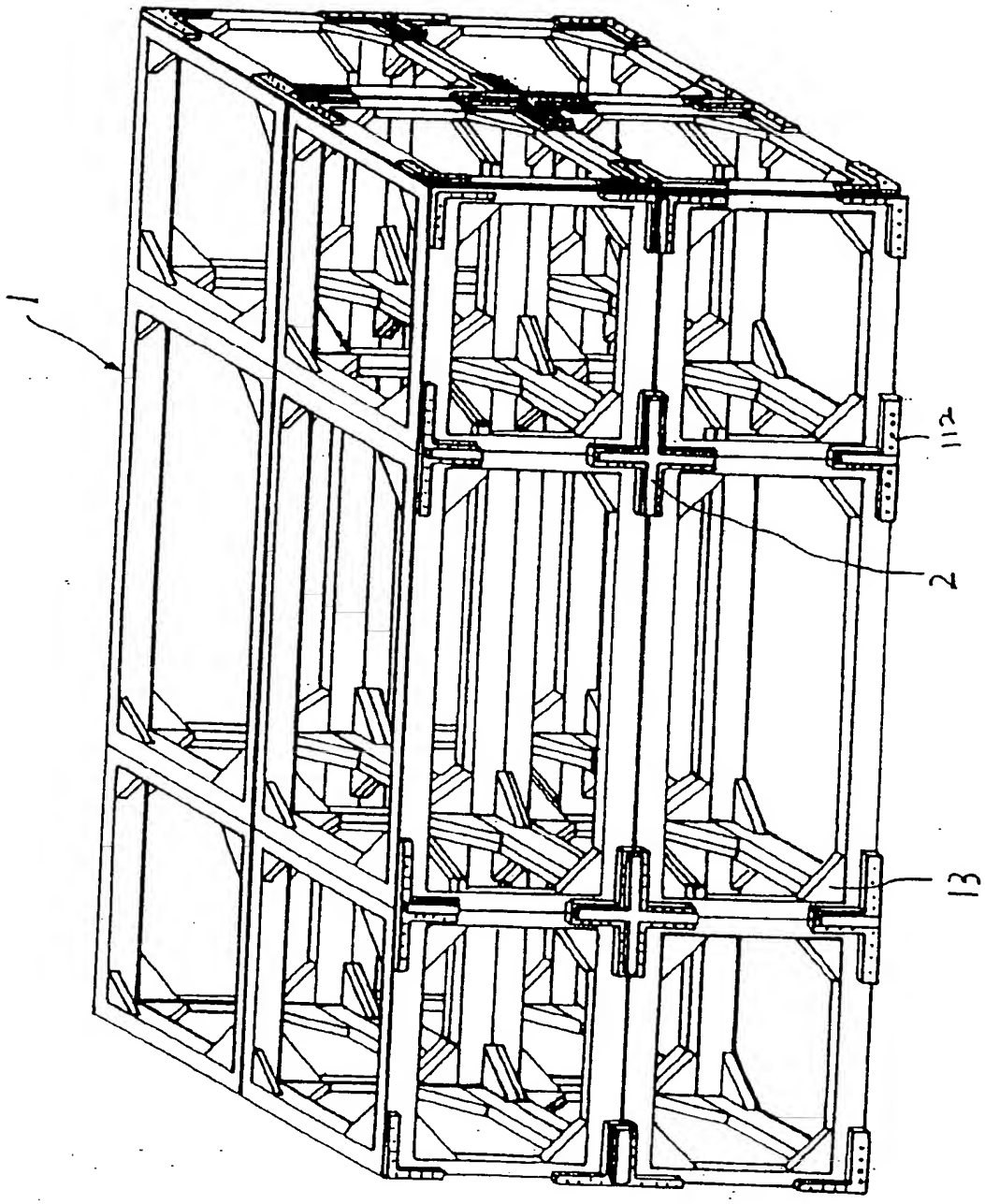


Fig 10

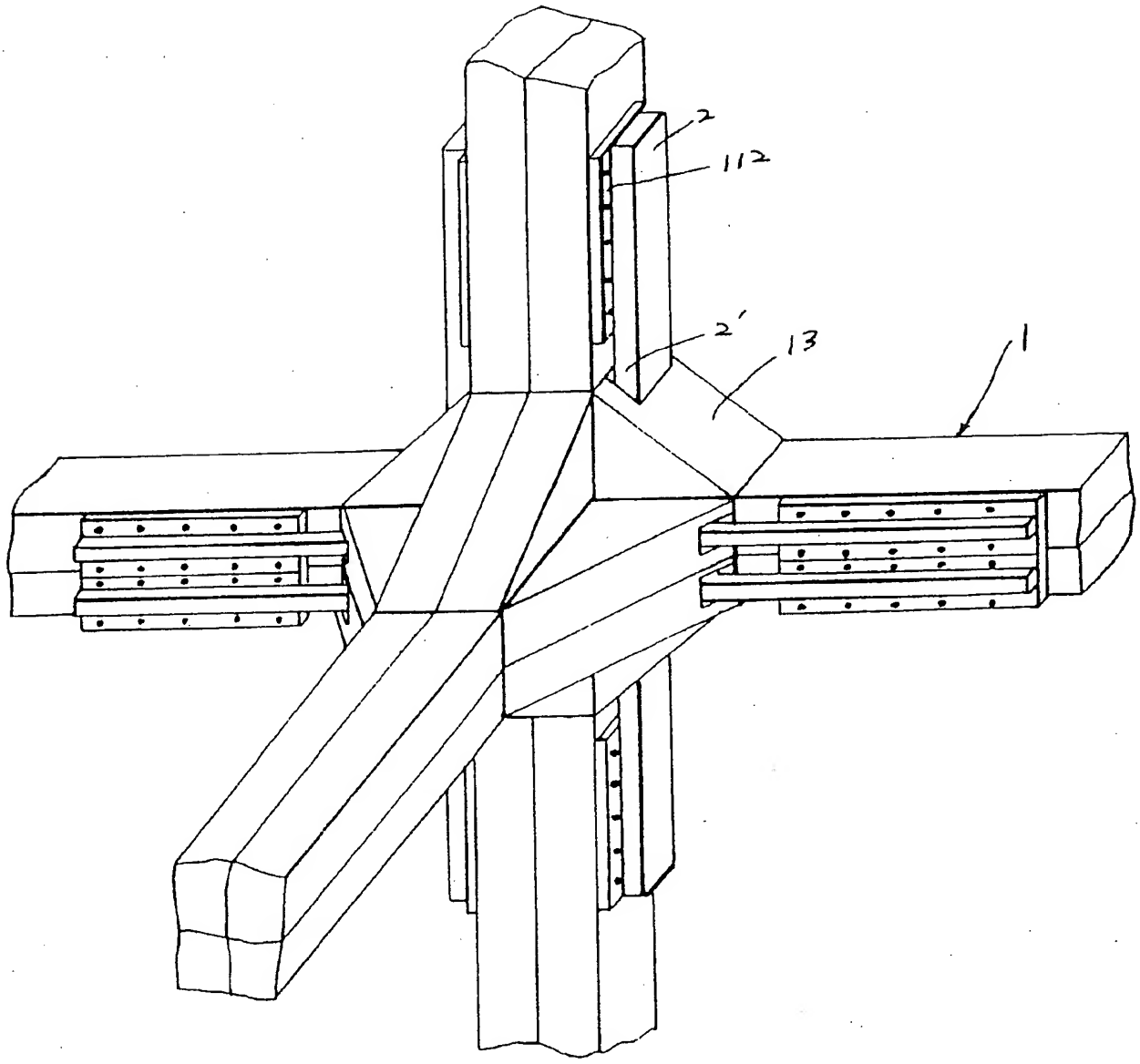


Fig. 11.

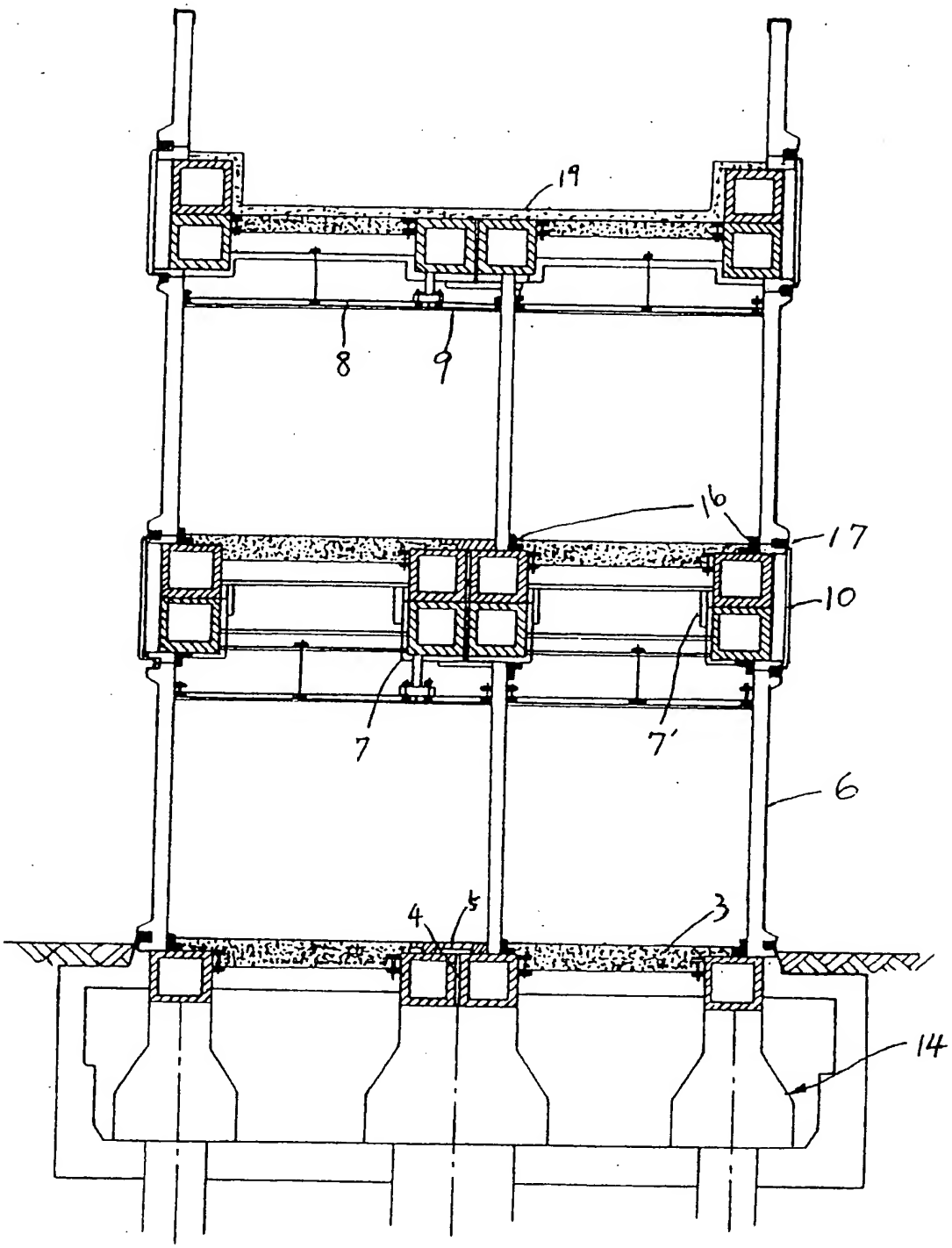


Fig 12

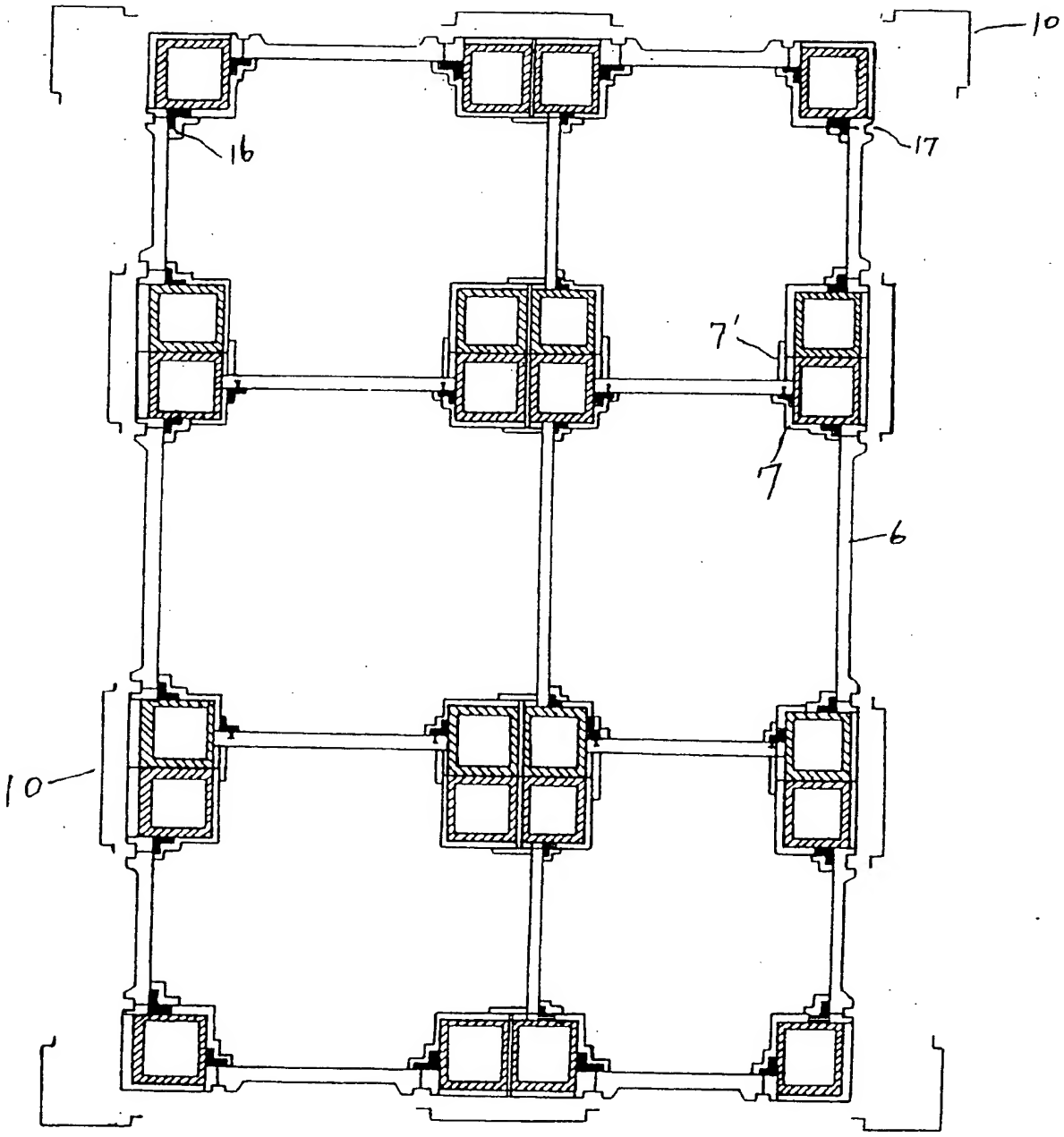


Fig 13

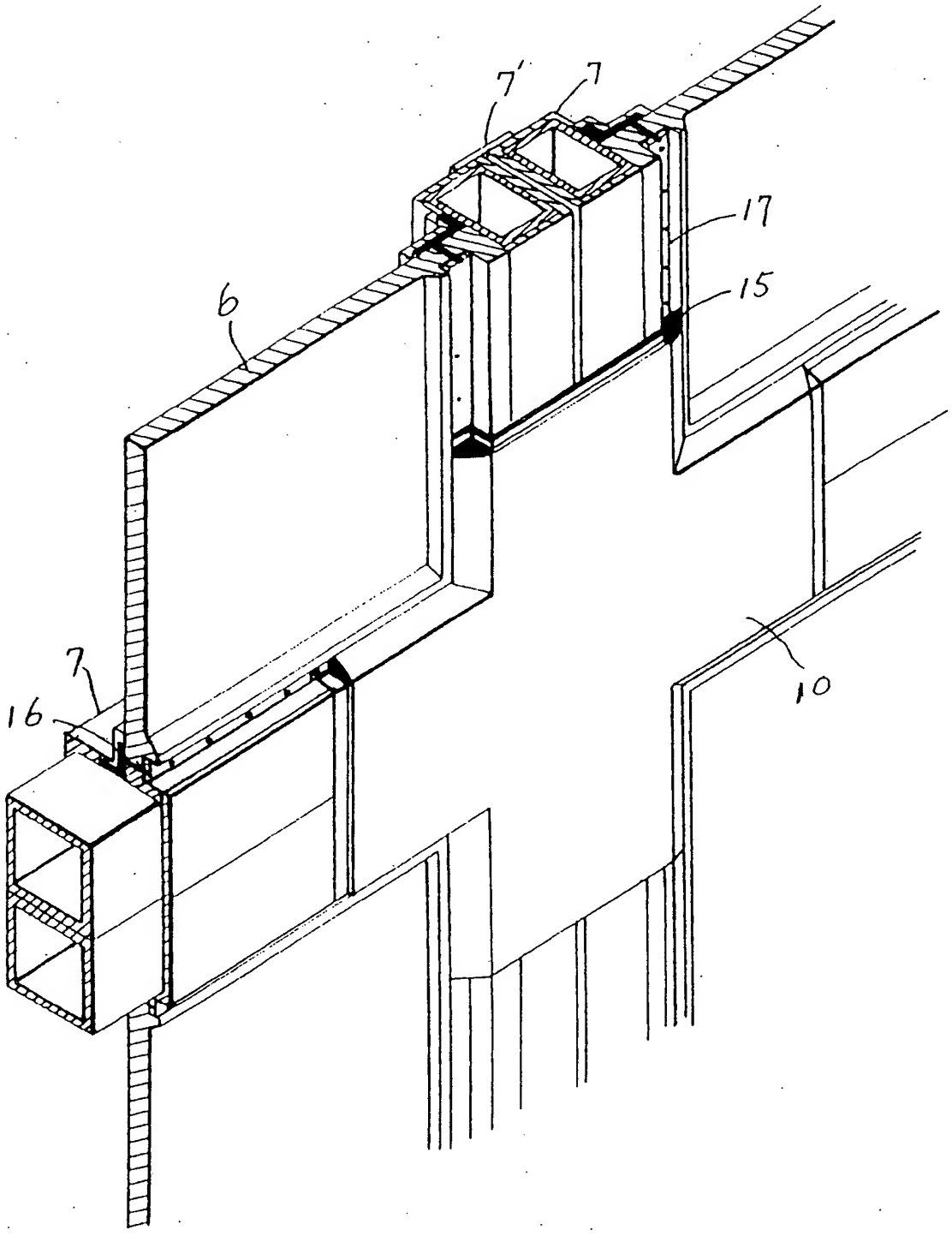


Fig 14

European Patent Office

EUROPEAN SEARCH REPORT

Application Number EP 93 30 1405

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	WO-A-8 203 418 (VON TELL NICO) * page 2, line 26 - page 4, line 22; figures 1-6 *	1,2	E04B1/348
X	US-A-4 854 094 (CLARK) * column 4, line 16 - column 5, line 30 * * column 6, line 51 - column 7, line 24; figures 1,2,6 *	1,2	
X	US-A-3 422 582 (LELY) * column 4, line 1 - column 6, line 45; figures 1,2,4,14,15 *	1	
A	US-A-3 716 959 (BERNARDI) * column 2, line 46 - line 57; figures 1,4 *	3	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	13 MAY 1993	BARBAS A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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